Consolidated Program for Research and Development for Welding of High Strength Steel Pipelines, #277 & 278

PUBLIC PAGE

QUARTERLY REPORT

Project WP#278: Development of Optimized Welding Solutions for X100 Line Pipe Steel

For Period Ending: November 30, 2008

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Prepared By: Marie Quintana
Principal Investigator
Lincoln Electric Company
22801 Saint Clair Avenue
Cleveland, OH 44117
216-383-2114
Marie_Quintana@lincolnelectric.com

Mr. Ian Wood
Team Project Manager
Electricore, Inc.
27943 Smyth Drive, Suite 105
Valencia, CA 91355
ian@electricore.org

Ken Lorang
Team Project Manager and Technical Coordinator
Pipeline Research Council, International
1401 Wilson Blvd., Suite 1101
Arlington, VA 22209
klorang@prci.org

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Background

To meet the increasing demand for energy in North America, oil and gas reserves in more remote and challenging regions are being developed where large volumes of natural gas will be transported by new long distance, high pressure transmission pipelines. Advanced pipeline designs utilizing high strength line pipe is a key element in meeting these increasing energy demands. A significant amount of laboratory research has been conducted on the development of X100 line pipe and associated welding technology; including, a few recent demonstration projects of limited size and scope. Accordingly, there are few welding process options proven for X100 and the knowledge resides within a small number of companies. The objectives of the proposed work are to establish the range of viable welding options for X100 line pipe, define essential variables to provide for welding process control that ensures reliable and consistent mechanical performance, validate the new essential variables methodology for relevant field welding conditions, and verify weldment performance through a combination of small and large scale tests. Full implementation will be achieved through changes to applicable codes and standards.

Progress in the Quarter

Project activities undertaken through the fifth quarter focused on (1) State of the Art Review; (2) Identification of Essential Variables; and (3) Fundamental Understanding of Welding Processes and Essential Variables. The work to develop the gap analysis for the welding of high strength steel pipelines is continuing.

A full project review meeting was held on October 20, 2008, at the Lincoln Electric Facilities. Joint web-conferences with Project 277 have been held once every two weeks. Specimen cutting plans were developed for the completed first round of girth welds. The project team has devoted considerable resources to develop in-situ measurement techniques for recording thermal history in the HAZ and weld metal. The developed techniques were applied to full-scale pipe girth welding that was completed in June 2008. Destructive tests on these welds are now underway. Preliminary thermal and microstructure models have been developed specifically for narrow-groove pipe girth welding of high strength steels. Initial comparison with prior experimental data showed that the models provide reasonable accuracy.

Three X100 line pipe steels have been selected for HAZ simulation studies; including generation of continuous cooling transformation (CCT) diagrams for the grain coarsen (GC) HAZ. Further detailed evaluation of HAZ structure and properties is also underway. A review of relevant

literature related to simulation of weld metal is currently underway. On-going discussions have focused on how to design a range of suitable welds that can be used to extract small-scale specimens for weld metal simulation studies.